I CLAIM:

1. A method of generating an analog acoustic output signal from an acoustic input signal in accordance with a configurable input/output characteristic, said method comprising the steps of:

(a) converting the acoustic input signal into a digital acoustic input signal;

(b) transforming the digital acoustic input signal into one or more frequency domain input signals;

(c) detecting the magnitude of each of the one or more frequency domain input signals;

(d) providing an adjustable digital loudness normalization control signal for controlling the configuration of said input/output characteristic;

(e) for each of the one or more frequency domain input signals, determining a gain value in response to the loudness normalization control signal and the magnitude of the frequency domain input signal;

(f) providing one or more frequency domain output signals by multiplying each of the frequency domain input signals by the corresponding gain value;

(g) transforming the one or more frequency domain output signals into a digital acoustic output signal; and

(h) converting the digital acoustic output signal into the analog acoustic output signal.

2. A method according to claim 1 further comprising the step of (i) independently adjusting the digital loudness normalization control signal to configure the configurable input/output characteristic in accordance with the preferences of a hearing impaired individual.

3. A method according to claim 1 comprising performing steps (c), (e), and (f) by means of a programmable digital signal processor.

4. A method according to claim 3 wherein step (e) comprises calculating the corresponding gain value for each of the one or more frequency domain input signals by means of a fitting formula programmed into said programmable digital signal processor.

5. A method according to claim 3 wherein step (e) comprises determining the corresponding gain value for each of the one or more frequency domain input signals by means of a look-up table stored in said programmable digital signal processor.

6. A method according to claim 5 wherein said look-up table is stored in non-volatile memory in said programmable digital signal processor.

7. A method according to claim 3 wherein step (e) comprises determining the corresponding gain value for each of the one or more frequency domain input signals by means of a fitting formula programmed into said programmable digital signal processor and a look-up table.

8. A method according to claim 7 wherein said look-up table is stored in non-volatile memory in said programmable digital signal processor.

9. A method according to claim 1 wherein step (b) comprises transforming the digital acoustic signal into at least two frequency domain input signals, each of said frequency domain input signals having a configurable channel input/output characteristic associated therewith, said configurable channel input/output characteristics together forming said configurable input/output characteristic, and wherein said at least two frequency domain input signals are provided with different channel input/output characteristics.

10. A method according to claim 1 wherein said configurable

input/output characteristic is a curvilinear compression characteristic.

11. A method according to claim 1 wherein said configurable input/output characteristic is an input compression characteristic.

12. A method according to claim 1 wherein said configurable input/output characteristic is an output compression characteristic.

13. A method of generating an acoustic output signal from an acoustic input signal in accordance with a configurable composite input/output characteristic, said method comprising the steps of:

(a) converting the acoustic input signal into a digital acoustic input signal;

(b) transforming the digital acoustic input signal into N frequency domain input signals, N being a positive integer greater than or equal to two;

(c) detecting the magnitude of each of the N frequency domain input signals;

(d) providing N adjustable digital loudness normalization control signals for controlling said configuration of said configurable composite input/output characteristic, each of the loudness control signals corresponding to one of the frequency domain input signals;

(e) determining N gain values, each of said gain values corresponding to one of said frequency domain input signals and each of said gain values being determined in response to one of said frequency domain input signals and to one of said adjustable digital loudness normalization control signals;

(f) multiplying each frequency domain input signal by its corresponding gain value to provide N processed frequency domain signals;

(g) transforming the N processed frequency domain signals into a digital acoustic output signal; and

(h) converting the digital acoustic output signal into the

acoustic output signal.

14. A method according to claim 13 further comprising the step of (i) differentially adjusting the N digital loudness normalization control signals in accordance with the preferences of a hearing impaired individual.

15. A method according to claim 13 comprising performing steps (c), (e), and (f) by means of a programmable digital signal processor.

16. A method according to claim 5 wherein said look-up table is stored in non-volatile memory coupled to said programmable digital signal processor.

17. A method according to claim 7 wherein said look-up table is stored in non-volatile memory coupled to said programmable digital signal processor.

18. A method according to claim 9 wherein each of said configurable channel input/output characteristics may be varied by adjusting said adjustable digital loudness normalization control signal.

19. A method according to claim 2 wherein the curvilinearity of said configurable input/output characteristic may be varied by adjusting said adjustable digital loudness normalization control signal.

20. A method according to claim 1 wherein said configurable input/output characteristic is a combination of two or more of:

(a) a curvilinear compression characteristic;

(b) an input compression characteristic; or

(c) an output compression characteristic.

21. A method according to claim 15 wherein step (e) comprises

calculating the corresponding gain value for each of the one or more frequency domain input signals by means of a fitting formula programmed into said programmable digital signal processor.

22. A method according to claim 15 wherein step (e) comprises determining the corresponding gain value for each of the one or more frequency domain input signals by means of a look-up table.

23. A method according to claim 22 wherein said look-up table is stored in non-volatile memory in said programmable digital signal processor.

24. A method according to claim 22 wherein said look-up table is stored in non-volatile memory coupled to said programmable digital signal processor.

25. A method according to claim 15 wherein step (e) comprises determining the corresponding gain value for each of the one or more frequency domain input signals by means of a fitting formula programmed into said programmable digital signal processor and a look-up table.

26. A method according to claim 25 wherein said look-up table is stored in non-volatile memory in said programmable digital signal processor.

27. A method according to claim 25 wherein said look-up table is stored in non-volatile memory coupled to said programmable digital signal processor.

28. A method according to claim 13 wherein said configurable input/output characteristic is a curvilinear compression input/output characteristic.

29. A method according to claim 13 wherein said configurable

input/output characteristic is an input compression input/output characteristic.

30. A method according to claim 13 wherein said configurable input/output characteristic is an output compression input/output characteristic.

31. A method according to claim 13 wherein the curvilinearity of said configurable input/output characteristic varies in response to a change in one or more of said adjustable digital loudness normalization control signal.

32. A method according to claim 14 wherein the magnitude of said gain values varies differentially in response to said differential adjustment of said digital loudness normalization control signals.

33. A signal processing apparatus comprising:

(a) an analysis filter for receiving a digital acoustic input signal and for providing N frequency domain input signals, wherein N is a positive integer;

(b) a loudness normalization adjustment stage for controllably providing a digital loudness normalization control signal;

(c) an input level detector coupled to said analysis filter for receiving said N frequency domain input signals and for providing N input level signals, each of said input level signals corresponding to one of said frequency domain input signals;

(d) an input/output transfer function stage coupled to said input level detector and to said loudness normalization adjustment unit for providing N gain signals in response to said digital loudness normalization control signal and said input level signals, each of said gain signals corresponding to one of said frequency domain input signals;

(e) a multiplier stage coupled to said analysis filter and to said input/output transfer function stage for providing N frequency domain

output signals in response to said frequency domain input signals and said gain signals; and

(f) a synthesis filter for receiving said N frequency domain output signals and for providing a digital acoustic output signal.

34. The apparatus of claim 33 wherein N is equal to or greater than two.

35. The apparatus of claim 34 wherein said input/output transfer function stage is configured to vary at least one of said gain signals by an amount different from at least one other of said gain signals in response to a change in said loudness normalization control signal.

36. The apparatus of claim 34 wherein said digital loudness normalization control signal comprises up to N channel digital loudness normalization control signals, each of said channel digital loudness normalization control signals corresponding to one or more of said input level signals.

37. The apparatus of claim 34 wherein said digital loudness normalization control signal comprises N channel digital loudness normalization control signals, each of said channel digital loudness normalization signals corresponding to one of said N input level signals.

38. The apparatus of claim 34 wherein said input/output transfer function stage includes a look-up table for determining the magnitude of at least one of said gain signals.

39. The apparatus of claim 34 wherein said input/output transfer function stage is configured to determine the gain value of at least one of said gain signals according to a fitting formula.

40. The apparatus of claim 34 wherein said input/output transfer function stage includes a look-up table and is configured to determine the gain value of at least one of said gain signals by means of a fitting formula and said look-up table.

41. The apparatus of claim 33 wherein said loudness normalization adjustment stage includes a signal controlling device for controlling said digital loudness normalization control signal.

42. The apparatus of claim 40 wherein said signal controlling device is a variable resistor.

43. The apparatus of claim 40 wherein said signal controlling device is a two-way momentary switch, wherein movement of the switch in a first direction causes the magnitude of said digital loudness normalization control signal to increase and movement of the switch in a second direction causes the magnitude of said digital loudness normalization control signal to decrease.

44. The apparatus of claim 41 wherein said signal controlling device may be manipulated by a user of said apparatus.

45. The apparatus of claim 34 wherein said N gain signals define an input/output characteristic correlating said digital acoustic input signal and said digital acoustic output signal and wherein said input/output characteristic is a curvilinear compression characteristic.

46. The apparatus of claim 34 wherein said N gain signals define an input/output characteristic correlating said digital acoustic input signal and said digital acoustic output signal and wherein said input/output characteristic is a stepped linear approximation of a curvilinear compression characteristic.

47. The apparatus of claim 34 wherein said N gain signals define an input/output characteristic correlating said digital acoustic input signal and said digital acoustic output signal and wherein said input/output characteristic is an input compression characteristic.

48. The apparatus of claim 34 wherein said N gain signals define an input/output characteristic correlating said digital acoustic input signal and said digital acoustic output signal and wherein said input/output characteristic is an output compression characteristic.

49. The apparatus of claim 34 wherein said N gain signals define an input/output characteristic correlating said digital acoustic input signal and said digital acoustic output signal and wherein said input/output characteristic is a combination of two or more of:

(a) one of (A) a curvilinear compression characteristic or (B) a stepped linear approximation of a curvilinear compression characteristic;

(b) an input compression characteristic; or

(c) an output compression characteristic.

50. The apparatus of claim 33 wherein said level detector, said input/output transfer function stage and said multiplier stage are implemented in a programmable digital signal processor.

51. The apparatus of claim 50 wherein said input/output transfer function stage includes a look-up table for determining the magnitude of at least one of said gain signals.

52. The apparatus of claim 50 further comprising a non-volatile memory coupled to said digital signal processor and wherein a look-up table is recorded in said non-volatile and wherein said input/output transfer function utilizes said look-up table for determining the magnitude of at least one of said gain signals.

53. The apparatus of claim 50 wherein said input/output transfer function stage is configured to determine the gain value of at least one of said gain signals according to a fitting formula.

54. The apparatus of claim 50 wherein said input/output transfer function stage includes a look-up table and is configured to determine the gain value of at least one of said gain signals by means of a fitting formula and said look-up table.

55. The apparatus of claim 50 further comprising a non-volatile memory coupled to said digital signal processor and wherein a look-up table is recorded in said non-volatile and wherein said input/output transfer function is configured to determine the gain value of at least one of said gain signals by means of a fitting formula and said look-up table.

56. The apparatus of claim 33 further comprising:

(a) a microphone for receiving an input sound energy signal and for providing an analog input acoustic signal;

(b) a A/D converter coupled to said sound reception device for receiving said analog input acoustic signal or an image of said analog input acoustic signal and coupled to said analysis filter for providing said digital acoustic input signal;

(c) a D/A converter coupled to said synthesis filter for receiving said digital output acoustic signal and for providing an analog output acoustic signal; and

(d) a speaker coupled to said D/A converter for receiving said analog output acoustic signal and providing an output sound energy signal.

53. The apparatus of claim 50 wherein said input/output transfer function stage is configured to determine the gain value of at least one of said gain signals according to a fitting formula.

54. The apparatus of claim 50 wherein said input/output transfer function stage includes a look-up table and is configured to determine the gain value of at least one of said gain signals by means of a fitting formula and said look-up table.

55. The apparatus of claim 50 further comprising a non-volatile memory coupled to said digital signal processor and wherein a look-up table is recorded in said non-volatile and wherein said input/output transfer function is configured to determine the gain value of at least one of said gain signals by means of a fitting formula and said look-up table.

56. The apparatus of claim 33 further comprising:

(a) a microphone for receiving an input sound energy signal and for providing an analog input acoustic signal;

(b) a A/D converter coupled to said sound reception device for receiving said analog input acoustic signal or an image of said analog input acoustic signal and coupled to said analysis filter for providing said digital acoustic input signal;

(c) a D/A converter coupled to said synthesis filter for receiving said digital output acoustic signal and for providing an analog output acoustic signal; and

(d) a speaker coupled to said D/A converter for receiving said analog output acoustic signal and providing an output sound energy signal.